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Northeast Semiconductor, Inc.

767 Warren Road, Ithaca, New York 14850
Office: (607) 257-8827
Fax: (607) 257-7540

June 30, 1992

Dr. Erhard Schimitschek, Scientific Officer
ATTN: Code 808
REF: N00014-91-C-0222
Naval Ocean Systems Center
271 Catalina Boulevard
San Diego, CA 92152-5000

Re:	Contractor	:	Northeast Semiconductor, Inc.
	Address	:	767 Warren Road, Ithaca, NY 14850
	Req. No.	:	s405811srv02/17 APR
	Contract No.	:	N00014-91- ,-0222
	Report Date	:	June 30, 1992
	Report Title	:	6th Monthly Technical Report
	Period Covered	:	06/01/92 through 06/30/92

Dear Dr. Schimitschek:

Northeast Semiconductor, Inc. encloses its Sixth Monthly Technical Report (Line Item #0002) pursuant to the provisions of contract Section B entitled, "Supplies or Services and Prices/Costs" for the period of June 1, 1992 through June 30, 1992.

Innovative Techniques for the Production of Low Cost 2D Laser Diode Arrays

1.0 OBJECTIVE

The primary objective of this program is to develop a low cost, high yielding methodology for processing, packaging and characterization of MBE grown two dimensional high power laser diode arrays. Projected increases in overall yield of AlGaAs diode lasers would reduce manufacturing cost from the current $10 to $20 per peak watt to below $3 per peak watt. Emphasis will be placed on innovative packaging techniques that will utilize recent advances in diamond heat sinking technology.

2.0 PROGRAM METHOD AND SCHEDULE

This program consists of four phases which will demonstrate reduced manufacturing cost and improved device performance of NSI's MBE laser diode arrays. The four phases listed below will result in milestones in processing, packaging, and testing along with delivery of the specified number of 5-bar laser arrays.

(i) Concept phase: Conceptual design and organization of this phase II program. NSI will utilize the current side cooled strained relief package to manufacture 5-bar laser diode arrays for base line evaluation. (Deliverables: 3 5-bar arrays.)

(ii) Backplane phase: Development of a copper backplane cooling technology that incorporates CVD diamond submounts. This phase will also include the completion of room temperature photoluminescence development. (Deliverables: 5 5-bar arrays.)

(iii) Diamond Backplane phase: Develop a CVD diamond backplane cooling scheme that will utilize smaller CVD submounts. The reduction in submount size is to decrease the thermal resistance from the laser bar to the backplane. (Deliverables: 5 5-bar arrays.)

(iv) Liquid Cooled Submount phase: An innovative liquid cooled package will be developed. The CVD diamond submounts will be hermetically sealed, electrically isolated and liquid cooled. (Deliverables: 5 5-bar arrays.)

The following global issues not mentioned above will be investigated continuously throughout all four phases of this program:

(1) design and development of a mask set to increase processing and packaging yields,

(2) development and updating of MBE growth software,

(3) design and development of an in-house facet coating station,

(4) evaluation of different facet coating materials,

(5) development of automated tests,

(6) life test and burn-in development.

The master schedule for this program is shown in Table 1. Each phase will require wafer growth, processing, assembly and test. The schedule shows the estimated number of sample fabrications and tests, as well as the time of hardware deliverables and reports.

3.0 PROGRESS THIS PERIOD

3.1 Wafer Growths

NSI has grown nine laser wafers this past month at the new MBE facility. This series of wafer represents NSI's first attempts at calibrating and qualifying the laser material at the facility. Initial results are encouraging with PL wavelength uniformity of approximately ±1 nm across the 3" wafers. A sampling of these wafers will be processed in July to accurately characterize the quality of the material and adjust growth parameters to optimize laser performance.

3.2 Processing

Difficulties were experienced in processing of the individual metalized material to investigate side wall passivation leakage. As mentioned in May's monthly report, material utilized for the first set of deliverables experienced infant life time mortalities. One possible cause for this failure was identified as side wall passivation break through. Therefore, it was decided to process the remaining half wafer (of this material) with individually metalized diodes. This would reduce the chance of current leakage through the side walls. Upon testing these arrays, it was discovered that the p-side metalization "stretched" during cleaving and encroached on the optical output regions. This contributed to poor device performance and resulted in unusable material. The fully metalized processed batch did not suffer from this condition. Efforts in the future will be focused on early detection of this process anomaly and investigation into possible corrective action.

3.3 Testing

Photoluminescence (PL) evaluation of the MBE laser wafers grown this period were performed. Improvements were made for increasing the sensitivity of NSI's current PL facility. These improvements involved reconstruction of the PL optical arena and focusing down the HeNe laser beam to a spot size of approximately 100µm. Additional reduction in the spot size is planned to increase the photon density and the stations overall sensitivity.

3.4 Assembly and Packaging

Efforts this period were focused on evaluation of CVD diamond. Progress has been hindered by a plaque of unreliable p-side solder joints. Initial InPb solder depositions ranged between 4.5µm to 5.5µm which is approximately 1.5µm to 2µm less than that utilized on Cu submounts. The decreased amount was attempted to reduce thickness and thermal resistance of the p-side solder joint and was believed possible with the improved surface conditions of the diamond. However, this resulted in inferior solder joints. Deposition was then done to the standard 7µm - 8µm

InPb solder. This also produced poor quality solder joints. Investigation is currently being performed to verify the purity of the evaporated solders and the integrity of the vacuum furnace utilized in this bonding operation. The possibility that the metalization provided by the diamond vendor is flawed is also being explored.

4.0 PLANS FOR JULY

The month of July will involve growing MBE laser material at NSI's new crystal facility. Investigation will continue into the CVD diamond heat sink difficulties described above. Fabrication of NSI's first backplane cooled package will begin.

Very truly yours,

Joseph A. Smart,
Co-Principal Investigator
Northeast Semiconductor, Inc.

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Encl: 1 Copy of 6th Monthly Technical Report

cc: (1 copy)
DCMAO Syracuse
ATTN: Mr. Robert Balstra,ACO
615 Erie Boulevard West
Syracuse, NY 13204-2408

(1 copy)
Director, Naval Research Laboratory
ATTN: Code 2627
Washington, DC 20375

(2 copies)
Defense Technical Information Center
Bldg. 5, Cameron Station
Alexandria, VA 22304-6145

(1 copy)
Strategic Defense Initiative Organization
ATTN: T/IS The Pentagon
Washington, DC 20301-7100

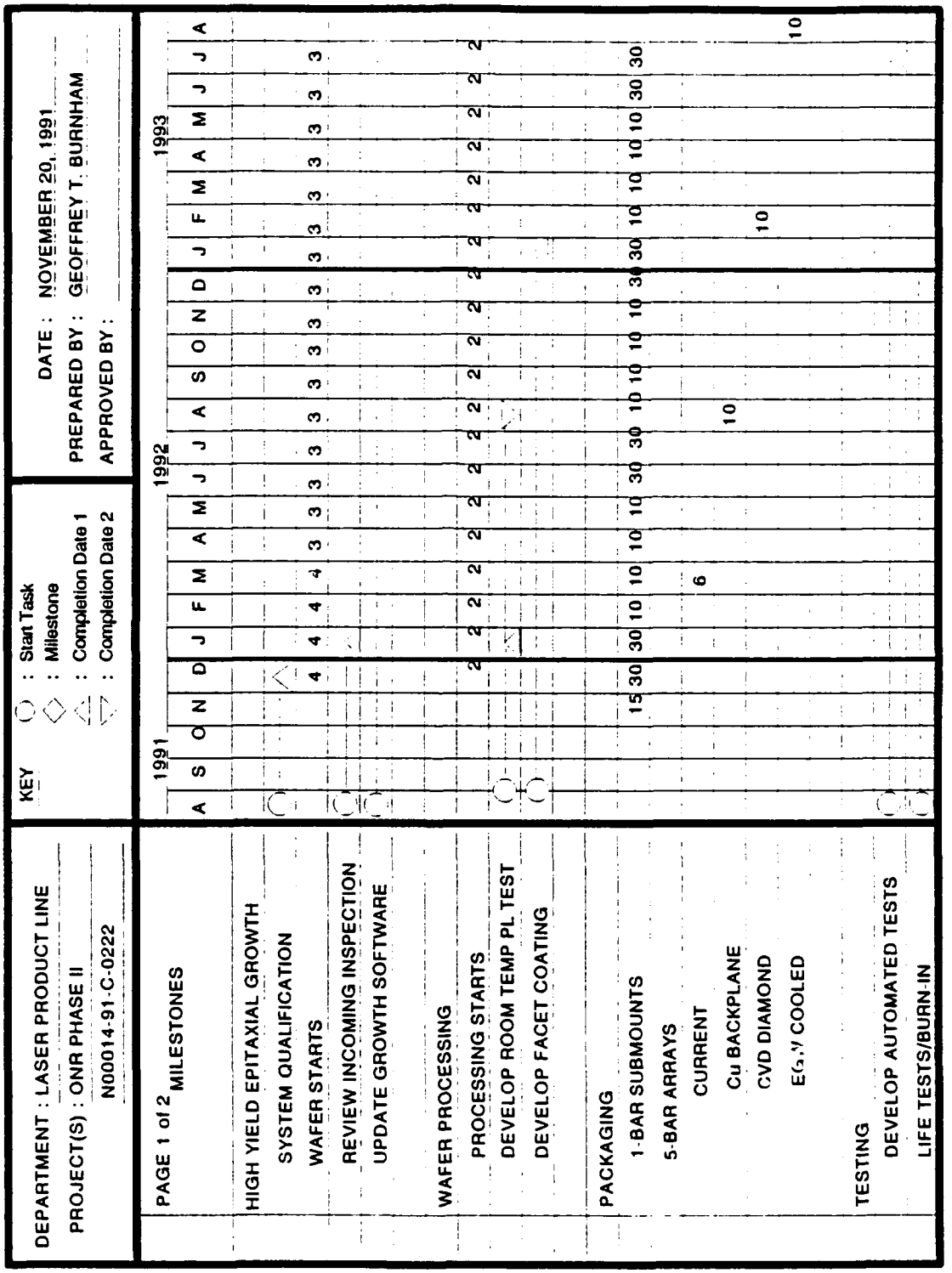

TABLE 1. MASTER SCHEDULE FOR SBIR PHASE I
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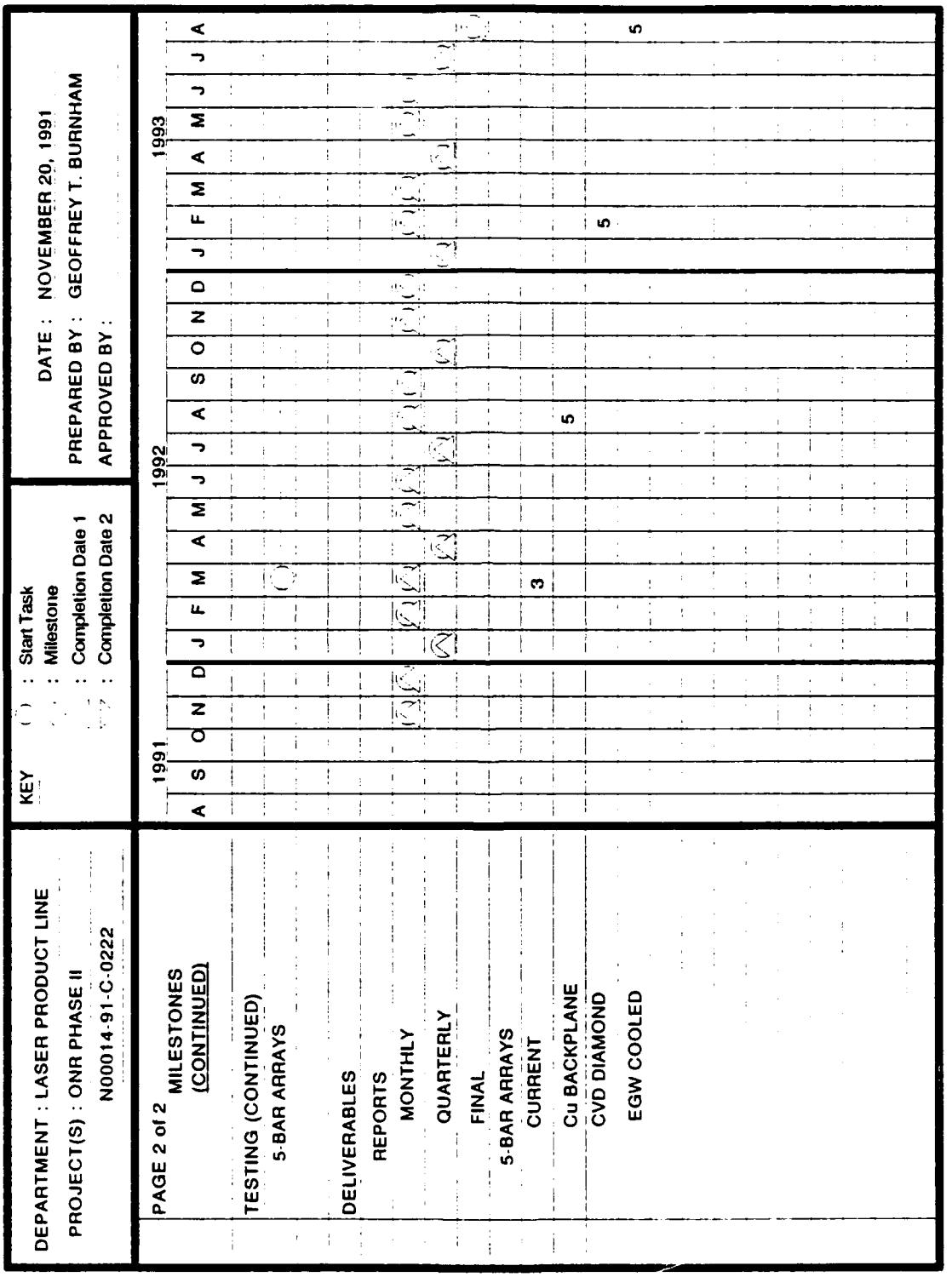
DEPARTMENT : LASER PRODUCT LINE
PROJECT(S) : ONR PHASE II
N00014-91-C-0222
KEY
: Start Task
: Milestone
: Completion Date 1
: Completion Date 2
DATE : NOVEMBER 20, 1991
PREPARED BY : GEOFFREY T. BURNHAM
APPROVED BY :
PAGE 2 of 2
MILESTONES
(CONTINUED)
1991
1992
1993
A S O N D J F M A M J J A S O N D J F M A M J J A
TESTING (CONTINUED)
5-BAR ARRAYS
DELIVERABLES
REPORTS
MONTHLY
QUARTERLY
FINAL
5-BAR ARRAYS
CURRENT
3
5
Cu BACKPLANE
CVD DIAMOND
5
EGW COOLED
5